SnT 2025 8 SEPTEMBER ONLINE DAY 9 TO 12 SEPTEMBER AT HOFBURG PALACE, VIENNA & ONLINE
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

A comparison of IDC Reviewed Event Bulletins with a baseline from the results of the 2024 Experiment

C. Saragiotis, C. Fernando, H. Hassani, J. Chaput and G. Graham

Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization

The 2024 Experiment, took place in September 2024 as part of the validation and acceptance test plan of the Provisional Technical Secretariat. Part of it was the comparison of the Reviewed Event Bulletin produced by IDC analysts with a baseline bulletin using prespecified metrics and requirements.

In this e-poster we present this comparison, the main results and findings, and conclusions drawn.

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Introduction

The 2024 Experiment was conducted during 16–27 September 2024 and included validation tests (VTs) covering several aspects of the IDC processing (automatic and interactive). In particular, for the purposes of "VT-IDC-3.1.3 Interactive analysis of SHI data and REB", the REB produced for Sep 15–17 2024 with a baseline bulletin independently produced several weeks later.

Metrics used and their requirements:

- Matched events rate: the percentage of baseline events listed in the REB (≥ 98%)
- Extra events rate: the percentage of REB events not listed in the baseline (≤ 4%)
- Error ellipse coincidence. (≥ 96%)

Comparison methodology

The comparison of the two bulletins was made using BulCMP, the software that is used at the heart of the performance reporting software, PRTool.

BulCMP matches considers event time, latitude and longitude and magnitude of events from different bulletins and matches them using a probabilistic technique [3] referred to as dynamic event matching.

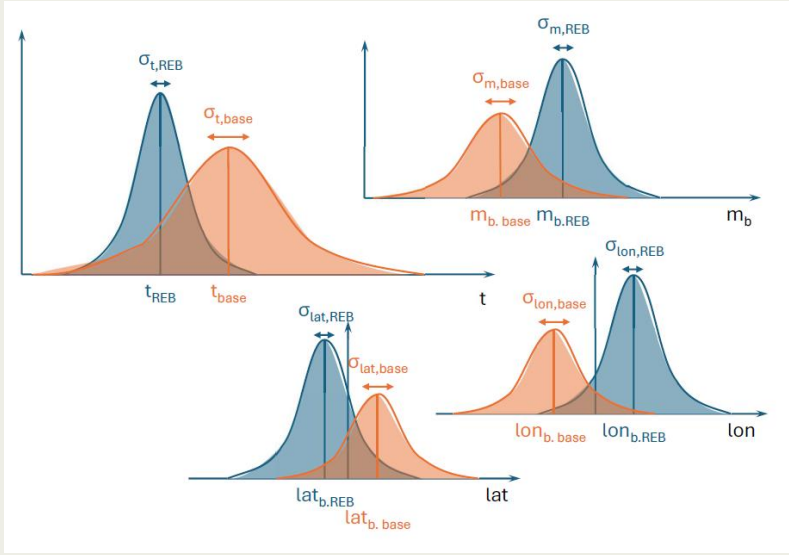
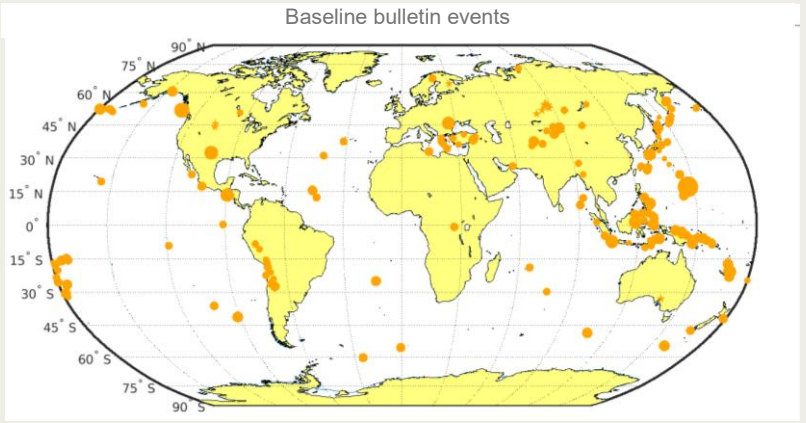


Figure. Parameters used by BulCMP to match evens.

Distribution of events



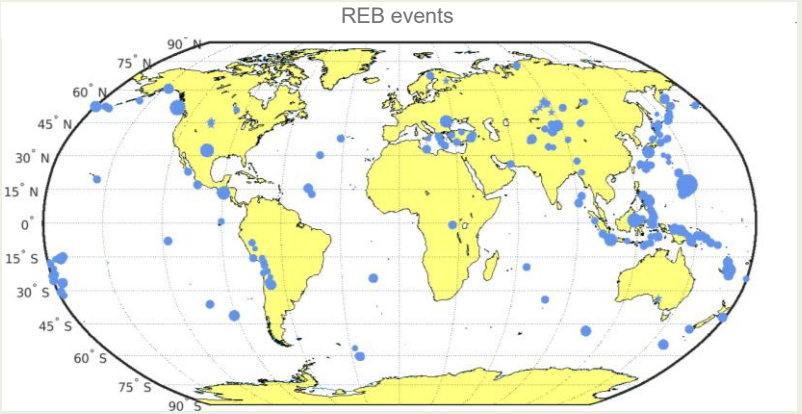


Figure. The size of the discs denotes m_b magnitude.

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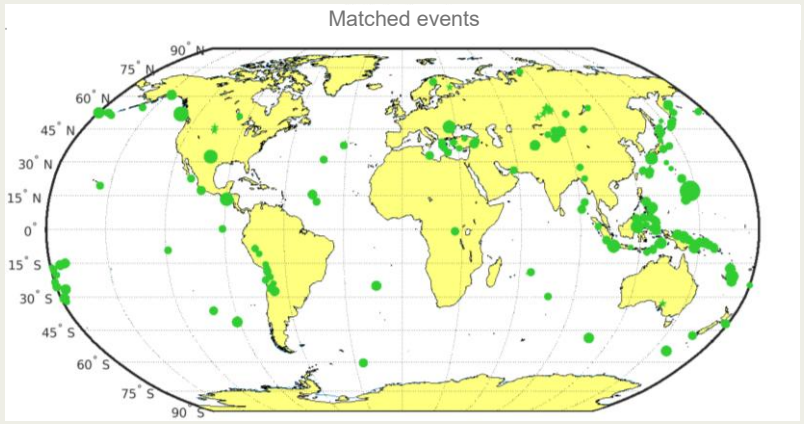
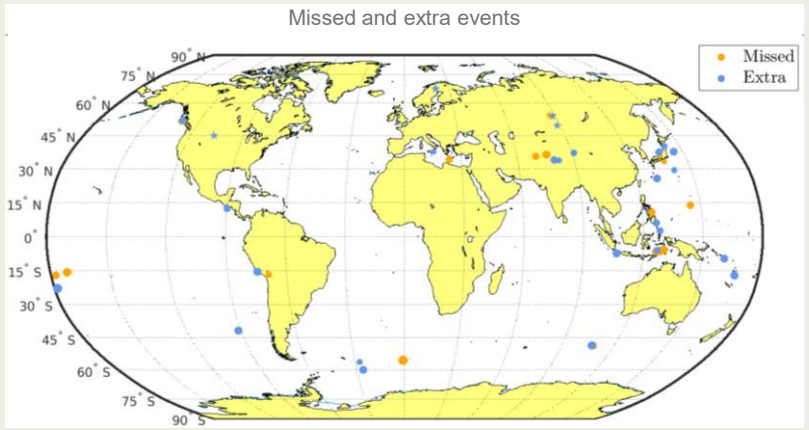
Distribution of events (cont'd)



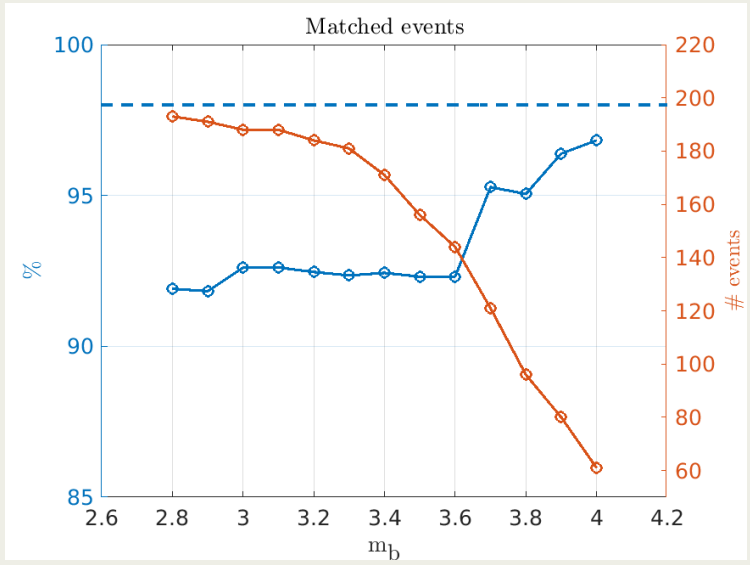


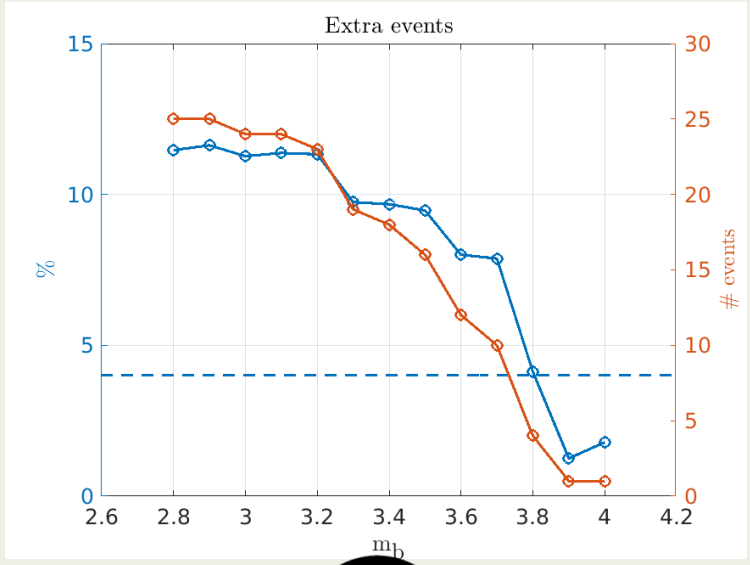
Metrics with respect to magnitude

When assessing whether the requirements have been met, several factors must be considered, including the estimated magnitudes. The number of events increases exponentially with decreasing magnitude (Gutenberg-Richter law) therefore comparing bulletins at low magnitudes is not meaningful. A magnitude threshold could be m_b 3.5, which is that considered for standard event screening. On the other hand, assuming underground nuclear explosions, tamped in hard rock and with no effort for concealment, a body wave m_b of 3.5 can correspond (depending on the geology) to yields of the order of 0.1 kt, that is, at the low end of the very-low yield range, which is 0.01 kt to 2 kt.

A magnitude m_b of 4.0 corresponds to a yield of 0.25 kt to 0.4 kt, still in the very low yield range. Thus, a threshold of m_b of 4.0 also is reasonable.

It is also noted that BulCMP considers the magnitude to match events. However, pure hydroacoustic or infrasonic events have no magnitude estimated at all and are therefore not considered by BulCMP. Furthermore, seismic events detected only by stations at regional distances (Δ < 20 deg) also do not have m_b magnitude estimates.





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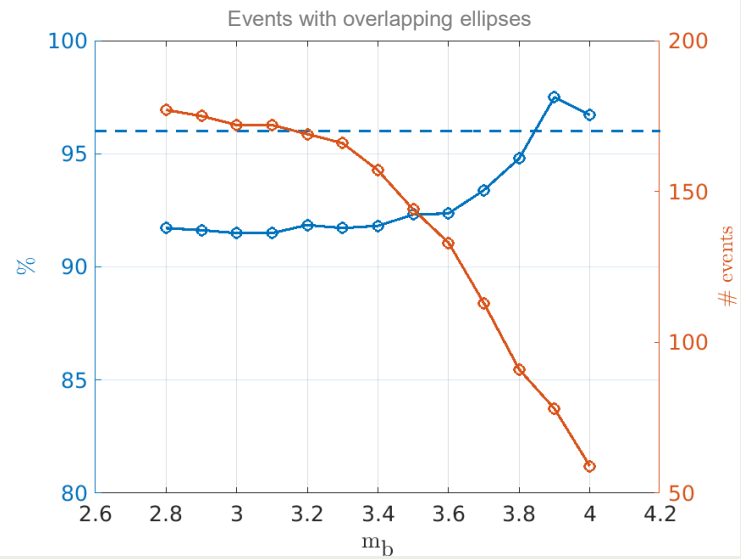
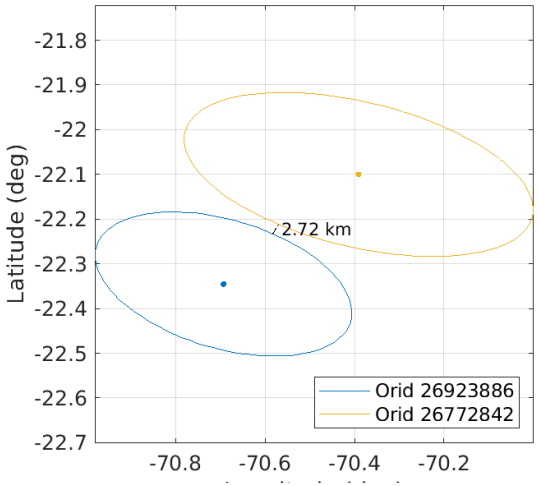
Metrics with respect to magnitude (cont'd)

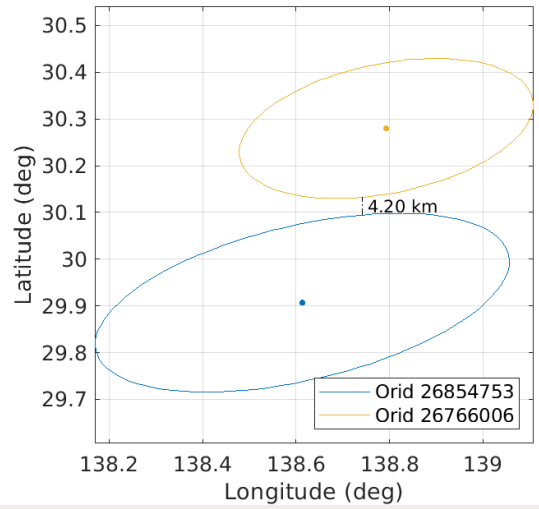


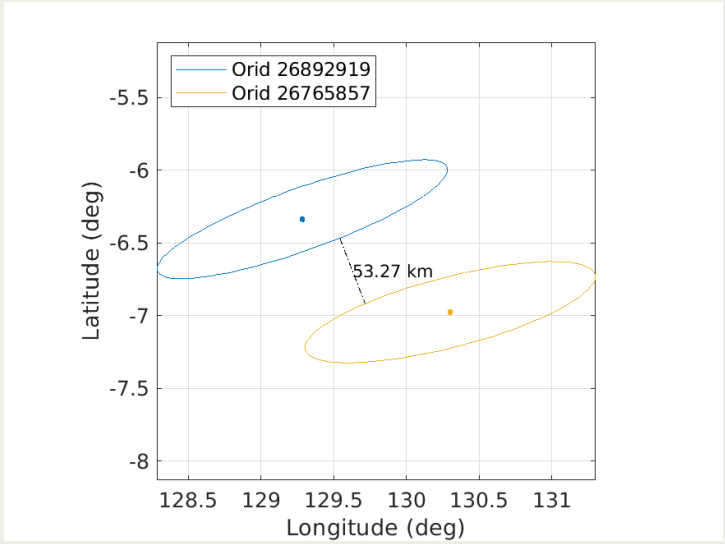
Summary of baseline and REB bulletins comparison

	Target	mb ≥ 4.0	mb ≥ 3.5	All events
Events in baseline		63	169	238
Events in REB		62	172	251
Matched	≥ 98%	61 (96.8%)	156 (92.3%)	215 (90.3%)
Extra	≤ 4%	1 (1.6%)	1 6 (9.3%)	36 (16.7%)
Overlapping ellipses	≥ 96%	59 (96.7%)	144 (92.3%)	193 (89.4%)

Examples of non-overlapping ellipses







References

[1] National Academy of Sciences (2002). Technical issues related to the Comprehensive Nuclear Test Ban Treaty. Washington DC: The National Academies Press.

[2] Provisional Technical Secretariat of the CTBTO Preparatory Commission (2024). IDC processing of seismic, hydroacoustic and infrasonic data. Rev. 3.1. IDC Documentation, IDC/OPS/MAN/001/Rev.3.1.

[3] Wüster, Jan et al. (2000). "GSETT-3: Evaluation of the detection and location capabilities of an experimental global seismic monitoring system". Bull. Seismol. Soc. Am. 90.1, pp. 166–186.

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